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AUGMENTED REALITY

Abstract: Augmented reality (AR) is a new technology. Very few people know about its development, which began in 1970s from massive and primitive devices. Now AR is at the very peak of its improvement in the form of various software. Augmented reality has its application in the following devices: glasses, phones, tablets. Augmented reality works on the basis of two stages: object recognition and marker tracking. Recognition occurs on the basis of machine learning and tracking of markers by finding certain elements or special markers. The analogue of this principle of operation is SLAM technology (Simultaneous Localization and Map Building). But the best results are achieved with the simultaneous use of two technologies. AR is involved in different areas: education, medicine, entertainment, military training. For education, three-dimensional 3D models are used, which are more visual for students and simplify their studies. In entertainment, AR has found a place for itself in various social networks in the form of masks (Snapchat), games (Pokemon GO) and others. In medicine, in addition to training, AR is used to visualize the internal organs of patients. Augmented reality has great potential for development in practical application in everyday life environments because it does not require high hardware characteristics.

Keywords: augmented reality, virtual reality, HoloLens, ARToolKit, recognition, specialized markers, SLAM, education, medicine.

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ДОПОЛНЕННАЯ РЕАЛЬНОСТЬ

Аннотация: Дополненная реальность, или AR (augmented reality) – новая технология, развитие которой сейчас мало кому известно. Она начала развитие в 70-х годах прошлого века от массивных и примитивных устройств. Сейчас же находится на самом пике своего совершенствования в виде различных ПО. Дополненная реальность имеет свое применение в следующий устройствах: очки, телефоны, планшеты. AR работает на основе двух этапов: распознавание объектов и отслеживание маркеров. Распознавание происходит на базе машинного обучения, а отслеживание маркеров путем нахождения определенных элементов или специальных маркеров. Аналогом данного принципа работы является технология SLAM. Но наилучшие результаты достигаются при одновременном использовании двух технологий. AR заполняет все больше сфер. Для образования используют объемные 3D модели, которые являются более наглядными для студентов и упрощают их обучение. В развлечениях AR нашло себе место в различных социальных сетях в виде масок (Snapchat), игр (Pokemon GO) и других. В медицине, помимо обучения, AR используют для визуализации внутренних органов пациентов. Дополненная реальность имеет большие возможности для развития в практическом применение в повседневных средах жизни, потому что не требует высоких характеристик аппаратных средств.

Ключевые слова: дополненная реальность, виртуальная реальность, HoloLens, ARToolKit, распознавание, специализированные маркеры, SLAM, образование, медицина.

Augmented Reality (AR) is a real-time environment that complements the physical world with digital data using devices (phones, tablets, etc.) and software. People often confuse this technology with Vitrual Reality (VR) and Mixed Reality. Unlike VR, AR does not create the whole artificial environment to replace real with a virtual one. VR interacts with users but AR interacts with all external world. Mixed Reality unites VR and AR.

History

Lyman Frank Baum first mentioned the idea of AR in the novel «The Master Key»; he described a device that could mark people in real-time with letters indicating their character and level of intelligence. In ancient times people had primitive AR-devices, such as roman masks for archers, which helped them to be more accurate, telescopes with distance markings and etc.

In 1968, Harvard computer specialist and professor Ivan Sutherland with his student Bob Sproullom developed the device called «The Sword of Damocles». It was the first system of exactly augmented reality based on the head display. In 1978, Steve Mann invented the first portative device for AR.

The first massive use of augmented reality was made possible thanks to Den Rayton, who in 1982 used a radar and cameras in space to show the movement of air masses, cyclones and winds in weather forecasts. AR is still used in this way. In the 90s, the research for new ways of using continued, and the scientist Tom Caudell first proposed the term «augmented reality».

In 1996, Jun Recimoto and Yuzhdi Ayattsuka developed the Matrix Method (or CyberCode). It described real and virtual objects using flat labels like QR codes (Quick Response Code). It allowed entering virtual things in real world, simply transferring tags.

In 1999, NASA used the augmented reality system in the dashboard of the X-38 spacecraft, which learned how to display objects on the Earth, regardless of weather conditions and actual visibility.

In the same year, Hirokazu Kato created an open library for writing applications with AR-functionality ARToolKit (still on GitHub). It used a system for recognizing the position and orientation of the camera in real time. The modern stage of active development of augmented reality began from the first version of this library.

How Augmented Reality works

Modern AR is a pattern recognition and marker tracking.

Recognition works in the following way: if the application needs to recognize the table, it is enough to upload a table photo library to the server, designate the general structure, colour, arbitrary parameters and assign this action to a specific action when it is detected in the image.

The second part is tracking the markers. Markers can act as a specially printed image. The magazine cover application recognizes the simple form with right angles and a specific pattern, and will track its position in space, noting the offset relative to the background. In this case, the cover itself is the marker. With special markers, everything is even simpler. The application simply imposes the desired image on the surface of a special marker.

SLAM (Simultaneous Localization and Map Building) is a way to recognize the environment and the location of a camera by decomposing a picture into geometric objects and lines. After that, the system assigns a point (or many points) to each individual form, fixing their location in spatial coordinates on successive frames of the video stream. Due to the fact that the algorithm allows us to memorize the position of points in space, returning to the same room from another we will see points in the same places where they were before.

For maximum efficiency, both approaches are combined for a specific task which leads us to the current situation.

Present: from glasses to phones

At the beginning of the development of AR it was clear that success of AR technology would depend on comfort for eyes using special devices.

The most popular event of Augmented Reality in recent years was Google Glass, released in 2013, with which there is a little confusion. When somebody talks about AR most people think exactly about this device, but Google Glass is not related to it.

Microsoft immediately took over the baton, after a couple of years it covertly announced and in 2016 presented the mixed reality glasses Hololens, but only for developers and journalists. The product is complex and it is still being developed.

Now there are about a dozen of the most promising developers and products for augmented reality in the form-factor of glasses: Vuzix, Sony, ODG, Solos, Magic Leap.

Nevertheless, AR is mostly found in phones: convenience, ready-made technical base, the prevalence of devices and ease of writing software.

Education

The prospect of seeing at universities, and after at schools, virtual interactive illustrations, which can be viewed from all sides, with which we can interact and immediately see the result of experiences, seems fine far from bright fantasies about the future. Training at any engineering specialties may become much more visible and easier to understand.

Medicine

Besides the most visual training of students at medical universities, AR can visualize data directly on the patient, instead of screens arranged around doctors' workplace.

HoloAnatomy from Hololens, which is about medicine and education, demonstrates visual anatomy in the augmented space.

Assistants for the blind report about objects and events around them or for the deaf show the subtitles. For example, startup Aira simultaneously offers a neural network assistant that recognizes and speaks everything that a camera of glasses sees, and a live employee of startup, which can help to orient with the same camera in a particulary difficult situation. This system depens on a smartphone application.

Augmented Reality is not just about games and self-masks with virtual masks. This is a huge number of opportunities for commercial use, new horizons in education, industry, medicine, construction, commerce and even tourism.

The commercial growth of AR is astounding. It, unlike VR, does not necessarily rely on specialized hardware and bulky devices. The technology works perfectly on the most mass wearable device – a smartphone.

The next step is a massive exit of AR from the zone of entertainment and social networks to the information support sector. Automakers (so far only Hyundai, BMW and Audi, but the list is growing) are starting to issue attachments to user instructions that help owners visually examine their cars. Amazon thinks about making it easier for buyers: if you like the sneakers on a passerby – point the phone at the person and order immediately the same ones.

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